The American Midland Naturalist

Devoted to Natural History,

Primarily that of the Prairie States

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VOL. XIV.—1933

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Kegelites, nom. nov.

Professor W. Kegel, of Berlin, has called our attention to the fact that the genus *Girtyites* Coryell and Booth, published in the AMERICAN MIDLAND NATURALIST, vol. 14, p. 261, 1933, has been used by W. Wedekind for a cephalopod in Palaeontographica, Bd. 62, p. 160, 1918. To express our appreciation for this aid from Professor Kegel, we have selected the name *Kegelites* for this ostracode genus.

H. N. CORYELL and R. T. BOOTH.

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Note:—Contributions on general and midland natural history will be gladly received. Papers on botany and allied subjects, zoology, geology and physical geography, should be addressed to the respective editors, whose addresses are given on the cover. Authors of papers on geology and paleontology are asked to confer with the editors before preparing copy of illustrations.

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VOL. XIV. JANUARY, 1933 No. 1.

NOTES ON THE MAMMALS OF ST. JOSEPH COUNTY, INDIANA

WILLIAM L. ENGELS

St. Joseph County is the central of the northern tier of Indiana counties, with Elkhart and La Porte Counties on the east and west, Stark and Marshall counties to the south, and Berrien and Cass counties, Michigan to the north. It occupies 477 square miles. This entire area is covered by glacial drift, averaging 200 feet in thickness; there are no rock outcroppings within the county. The soil consists of sand or gravel, clay, loam, muck, and a characteristic Kankakee marsh land soil. Large portions of the western half of the county were originally tongues of the prairie; one such, lying in German Township, between the Kankakee and St. Joseph Rivers, was termed Portage Prairie. The county is dotted with small lakes and marshes; a number of tamarack bogs form a special feature of the topography.

The northern part of the county lies largely in the St. Joseph river valley, and so is drained into Lake Michigan; for the most part, the southern half is drained by the Kankakee, a tributary to the Illinois. The "divide" is a series of low hills forming an ill-defined ridge separating the north central part of the county from the remainder.

Just north of Notre Dame is Portage Prairie, less than five miles wide, separating the St. Joseph from the headwaters of the Kankakee. This portage was one of three used by the early explorers and travelers to enter the Louisiana Territory from the Great Lakes. As a result of commanding this important position on a main highway of pioneer travel,

the native fauna of what is now St. Joseph County was observed by figures famous in American history—La Salle, Marquette, and Allouez among others. The narrative of Father Hennepin, La Salle's companion and historian, abounds with references to the plentiful game of the St. Joseph Valley. Traders, following in the wake of these first travelers, found in this valley a profitable and prosperous home, and their journals and day books provide references to the abundance of the native fauna of the district. Thus it is recorded that one Wm. Burnett, a trader situated on the St. Joseph river, received during the period 1800-1801, the following skins: Beavers, 9; Otter, 119; Bear, 10; Elk, 1; Mink, 248; Deer, 1076; "Cat," 62; Muskrat, 2014; Fox, 107; Redskin, 518; Raccoon, 5603. However that day is long since past; a modern manufacturing city of more than 100,000 inhabitants occupies the site of the little Pottawattomie village visited by the pioneer missionaries, the beautiful river on which they plied their paddles is blocked by a series of power dams, the forests are cut, the marshes drained, the prairies tilled. The cottontailed rabbit is the hunters' largest game; skunk, mink, and muskrat alone remain to the trapper.

The sole account of the natural history of the county appears to be one contained in the *History of St. Joseph County, Indiana*, published in Chicago, 1880, editors and collaborators unnamed. Among the "quadrupeds" listed as exterminated or driven out are buffalo, beaver, elk, badger, panther, black wolf, and black bear. The "gray fox, catamount, otter, lynx, deer, opossum, raccoon, mink, muskrat, common weasel, small brown weasel, skunk, woodchuck, prairie mole, common shrew mole, meadow and deer mouse and gray rabbitt" are said to be less common than formerly. Of squirrels "there are: gray timber squirrel, fox, chipmunk, the large gray prairie squirrel, the striped and the spotted prairie squirrel, and the flying squirrel. The dark brown and reddish bat are common."

This list is to be suspected of having been compiled from some current book of natural history, rather than from observation within the county. If it is authentic, then it provides the first county record for the gray squirrel, *Citellus franklinii*. The "small brown weasel" refers probably to the

female of the common weasel, which is very much smaller than the male.

The present list includes 49 species, 31 of which are known definitely to inhabit the county at the present time. To these 30 species should be added several which undoubtedly are part of the fauna, but of which I was unable to obtain records. These include the Star-nosed Mole, *Condylura cristata*, the small Short-tailed Shrew, *Cryptotis parva*, the Little Brown Bat, *Myotis lucifugus*, the Little Gray Bat, *Myotis grisescens*, *Myotis sodalis*, and the Keen Bat, *Myotis keenii*. At least one species of the *Myotis* is common on the campus at Notre Dame, easily distinguishable on the wing from the known bats of the county, but I was unable to collect any specimens. Two Long-tailed Shrews, *Microsorex hoyi* and *Sorex fumeus*, may possibly occur in the county, the latter perhaps in some of the cold tamarack bogs.

Didelphis virginiana virginiana Kerr. Opossum. Common throughout the county. Seminarians at Notre Dame who were active in the Bird Banding Survey frequently found them in their bird traps; during the spring of 1931 they captured eight in this way. They are occasionally to be seen on the campus at Notre Dame. The opossum is one of the oldest known inhabitants of this district. Father Hennepin (1683), describing La Salle's return to his camp at the St. Joseph-Kankakee portage after an over-night absence says: "He had two animals of the size of muskrats, hanging at his belt . . . which he had killed with blows of a stick, without these little animals taking flight, and which often let themselves hang by the tail from branches of trees, and . . . they were very fat." (Shea Transl., p. 137). This is probably the first written record of the opossum in Indiana. A mural in the St. Joseph County Courthouse, in South Bend, called "La Salle at the Portage," shows him with two 'possums hanging at his waist. Specimens: 4.[1]

[1] Unless otherwise designated, specimens referred to are in the collection at the University of Notre Dame. Abbreviations: U. N. D., University of Notre Dame; U. S. N. M., U. S. National Museum; F. M., Field Museum; N. Z. P., National Zool. Park; M. N. I. H. S., Museum, Northern Indiana Historical Society, South Bend, Ind.

Scalopus aquaticus machrinus (Raf.). Prairie mole. Very common. Moles are well-known lawn pests throughout South Bend; on the Notre Dame campus they are numerous. Their characteristic runways are to be seen in every woodlot and pasture. Mr.Phil Trexler caught from 2 to 3 moles per day for several days in the same set in one runway, in a recently dry creek bed in which the ground was still moist. Specimens: 5.

Condylura cristata (L.). Star-nosed Mole. This species was reported by S. Tenny from Niles, Mich., a few miles north of the county and probably occurs here. No specimen is known to have been taken.

Sorex cinereus cinereus Kerr. Long-tailed Shrew. Found to be very common in at least one locality within the county, but apparently absent or rare in various other similar habitat localities. On the Chas. Nemeth farm near North Liberty eleven shrews were collected in two weeks in a little used pasture bordering a creek, and in rank, damp grass along the foot of a low ridge on the opposite side. In three weeks of collecting in a drained tamarack swamp west of Sousley Lake, near the La Porte County line, one shrew was taken. Mr. Phil Trexler collected one close to the bank of a small creek near State Line. Specimens: U.N.D. 12; U.S.N.M. 1.

Blarina brevicauda brevicauda (Say). Short-tailed Shrew. This apparently is the most common small mammal in the county, rivalling in numbers the White-footed Mouse. It is not an uncomon experience to take nothing but these shrews in trap-lines with five per-cent yield. They are found in all sorts of habitats, but seem to be more common in fairly dry, brushy fields and on hillsides. One which was uncovered while digging along the bank of State Creek, north of Notre Dame, took to the water unhesitatingly when chased, but turned back immediately toward the land. They may be more aquatic than is commonly supposed. Dr. Will Scott took one from the stomach of a gar-pike a few years ago. Specimens: 15.

Eptesicus fuscus fuscus (Beauvois). Big Brow Bat. The most common bat of the vicinity. They are not infrequently

found about the buildings on the campus during the winter; during the summer months they often enter buildings while flying at night. From April to July, 1931, I caught three in my laboratory with a butterfly net. They skillfully avoided the net when it was swung toward them head-on, but were easily captured by a stroke from behind as they flew past. A female caught in the University Gymnasium on March 18, 1931, was killed soon after capture and the genital tract sectioned for study. Ovulation had apparently just taken place; five oviducal eggs were located and hundreds of sperm were found nestled between the folds of the uterine mucosa. Specimens: 4.

Lasionycteris noctivagans (Le Conte). Silver-haired Bat. Specimen: 1. U.S.N.M.

Lasiurus borealis borealis (Müller). Red Bat. One young specimen was taken a number of years ago in Science Hall at Notre Dame, and preserved in alcohol; no other data. Specimen: 1.

Lasiturus cinerus (Beauvois). Hoary Bat. One specimen was taken at Notre Dame by the Rev. A. M. Kirsch, C.S.C., in 1910. The skull is now in the U. S. National Museum. Specimen: 1.

Euarctos americanus americanus (Pallas). Black Bear. Father Hennepin says that during November, 1679, while building Fort Miasmis at the mouth of the St. Joseph River, mutiny threatened because the men had nothing but bear meat to eat. He adds: "There were at this place many of these animals, that were attracted to it, by the great quantities of grapes growing everywhere there." (Shea Transl., p. 132.) This was in Berrien County, Michigan, immediately north of St. Joseph County, Indiana, and indicates the abundance of black bears in this general locality. However they have long since been driven out of these parts. Mr. Robert Geyer, of North Liberty, says that a story was told of his grandfather encountering a black bear near his farm there in the early days (about 1840). They were already scarce at that time, and the last one was killed probably not much later.

Procyon lotor lotor (Linn.). Eastern Raccoon. Hahn (1907) lists raccoons as abundant in the Kankakee Valley region. They were undoubtedly common in St. Joseph County up to quite recent times.

Martes americana (Turton). Marten. May have existed in this district in former days, but I am unable to find any reference to it.

Martes pennanti (Erxleben). Fisher. Like the last, there are no records for the Fisher in St. Joseph County, but it once probably ranged through this district.

Mustela noveboracensis noveboracensis (Emmons). New York Weasel. Probably common throughout the county. One was captured in a bird trap used by local bird banders. One was caught in a steel trap set without any precautions in the runway to its den in a pile of rocks at one end of a culvert. Specimens: 2.

Mustela vison mink (Peale and Beauvois). Mink. Rather common in the marshes and along the lakes and streams of the county. A family was known to be living on the banks of the St. Joseph River under the north end of the Grand Trunk Railway bridge within the city of South Bend, in 1931. A farmer boy living near Sousley Lake who trapped around there in 1931-32 reported mink to be very numerous.

Mustela rixosa allegheniensis (Rhoads). Least Weasel. This species is believed to occur throughout the northern part of the state although the only specimen ever taken came from Bluffton.

Gulo luscus (Linn.). Wolverine. Probably once native to the county, but I have been unable to obtain any record.

Lutra canadensis (Schreber). Otter. Hahn (1907) reports otter to be scarce in the Kankakee Valley region but says that some still were being taken by the trappers. According to Mr. Robert Geyer, of North Liberty, five otters were killed on Grapevine Creek, a tributary of the Kankakee, in 1905. These may have been the last otters in St. Joseph County.

Mephitis nigra (Peale and Beauvois). Eastern Skunk. A common and well-known resident of the county, whose scent is familiar to all. In 1925 a too enthusiastic watchman shot one in a covered passageway connecting a dormitory and class building at St. Mary's Academy — the passage was perforce closed to pedestrians for several months. Specimens: 2.

Taxidea taxus taxus (Schreber). Badger. Lyon (1932b) records the killing of a badger on a highway in the southern part of the county; Mr. C. S. Robbins, the taxidermist who mounted the specimen, gave the skull to the U. S. National Museum. Lyon also records the killing of a badger (a second escaped) near New Carlisle in August, 1930 by Fred Predmore of South Bend and two companions. Mr. Robert Geyer of North Liberty says that the rural mail carrier killed two on the road near there in 1930. Specimen: U.S.N.M. 1.

Vulpes fulva (Desmarest). Red Fox. No records are known but it has undoubtedly been found in the county. It still inhabits the Indiana Dunes region to the west. The "redskins" of Trader Wm. Burnett's list of 1800-1801 may have referred to this species.

Urocyon cinereoargenteus (Schreber). Gray Fox. A once common animal in the county, but not known here for many years. In the 1880 list (anon.) it was said to be "less common than formerly." There is a skull in the U.S.N.M. from an animal hit by a motor car in La Porte Co., in 1929-30.

Canis latrans Say. Coyote. Lyon (1924) records a coyote killed by August Buysse and C. Sargent, March, 1923, in the southwestern part of St. Joseph County. A male coyote was shot near North Liberty, Feb. 15, 1928, by E. Hosler, and obtained by Dr. M. W. Lyon, Jr., for the Field Museum of Natural History. Specimen: F.M. 1.

Canis lycaon Schreber. Wolf. Hahn (1907) states that a small number of wolves were said to live at that time in the Kankakee swamp. The last wolves probably left St. Joseph County some years before this.

Lynx rufus (Schreber). Bobcat; Bay Lynx. Scattered references in county histories are made to "catamounts" or "wild-cats," probably referring to this species. *Lynx canadensis* Kerr may also have formerly occurred in this county; I have been unable to obtain any records.

Marmota monax monax (Linn.). Woodchuck; Ground Hog. Very common. Specimen: 1.

Citellus franklinii (Sabine). Franklin's Spermophile; Gray Ground- or Prairie Squirrel. Confined to Lincoln, Liberty and perhaps the western part of Greene Townships, in the southwestern part of the county. Mr. Robert Geyer, who was born, reared, and who spent practically all his life, on his farm near North Liberty, says that these "gophers" have appeared on his farm only within recent years. Lyon, 1924, records it from Walkerton, near the La Porte County line; the same writer (1932a) records specimens taken near North Liberty, west of Sousley Lake, by himself and the author. Specimens: U.N.D. 3; U.S.N.M. 1; N.Z.P. 1.

Citellus tridecemlineatus tridecemlineatus (Mitchill). 13-lined Spermophile; Striped Ground Squirred. This is one of the most numerous rodents. Dozens live on the main campus at Notre Dame. Specimens: 3.

Tamias striatus fisheri Howell. Chipmunk. Fairly common in dry bushy areas. In St. Mary's ravine, near Notre Dame, they are quite numerous. Specimens: 9.

Sciurus hudsonicus loquax Bangs. Red Squirrel. Common. The local name is "piney," "red-squirrel" being used for the larger Fox Squirrel. This is the only squirrel found on the Notre Dame campus, although in South Bend, fox squirrels are numerous. During the open winter of 1931-32 one nested in a striped ground squirrel's burrow on the main quadrangle and another in an underground drain near the postoffice. Mr. Al Tansey of South Bend says that about 1915 there were a pair of albino pineys living on the campus. Specimens: U.N.D. 5; U.S.N.M. 1.

Sciurus carolinensis Gmelin. Gray Squirrel. No definite county record, except for the anonymous list of 1880. Gray

squirrels were undoubtedly once a resident of the county, but are now either absent or very scarce.

Sciurus niger rufiventer (Geoffroy). Fox Squirrel. A fairly common squirrel in wooded areas. It has made its home in several parks and among the trees along a number of residential streets in South Bend. Specimens: 2.

Glaucomys volans volans (Linnaeus). Flying Squirrel. Probably not rare in St. Joseph County, but because of its nocturnal habits it is rarely seen even in localities where it is abundant. One specimen was taken by a party of seminarians from Notre Dame north of the University. Dr. Rausch of South Bend reports that a family of flying squirrels inhabited the attic of his home a few years ago. A mounted specimen in the Museum of the Northern Indiana Historical Society in South Bend is said to come from this county. Specimen 1.

Castor canadensis michiganensis Bailey. Beaver. Once plentiful; Hahn (1909) is of the opinion that the beaver was exterminated all over the state not later than 1840. Bartlett and Lyon (1899) says that La Hontan, who viewed this region during La Salle's time, represents the Kankakee as arising in a lake (Chain Lakes?) surrounded by a great beaver town. (p. 62.) The same authors mention an enthusiastic letter to the French crown by D'Iberville declaring that this western land had great natural wealth, and that the region of the Kankakee and the St. Joseph was the place where "beavers are plenty" (p. 63). Almost every farmer in the county claims to know of old beaver dams which are still visible in the drained Kankakee district. One such that may be authentic is located near the north end of Sousley Lake, about eight miles southwest of South Bend.

Peromyscus maniculatus bairdii (Hoy and Kennicott). Prairie White-footed Mouse. No extensive collecting was done in areas which this mouse might inhabit, so I am unable to say how common it may be. Specimens: 2.

Peromyscus leucopus noveboracensis (Fischer). Deermouse. Certainly the most common rodent; it rivals *Blarina brevicauda* in numbers. Mr. Phil Trexler, in the spring of

1932, located a nest in a willow tree, about twenty feet above the ground, in a cavity about two feet deep. It appeared to be an old nest, and was made of grasses and hair; there were about six inches of droppings and debris at the bottom of the cavity. The nest was inhabited by a mother with three young. Specimens: 21.

Synaptomys cooperi stonei Rhoads. Stone's Lemming Mouse. Five specimens of this uncommon lemming were collected by one of my students, Mr. Phil Trexler, near State Line. They were taken in traps baited with Anthony's combination bait, set in rank grass several feet from the bank of a small creek. Specimens: 5.

Microtus pennsylvanicus pennsylvanicus (Ord). Meadow Vole; Meadow-Mouse. Fairly common. All of the specimens collected were taken in marshes, low meadows, or in rank grass at the foot of hills. Specimens: 8.

Microtus ochrogaster (Wagner). Yellow-bellied Vole. No special effort was made to collect this mouse, but its characteristic cuttings were frequently observed, and it probably is not uncommon. Mr. Phil Trexler collected three near State Line. Specimens: 3.

Pitymys pinetorum scalopsoides (Audubon and Bachman). Pine-mouse. Not numerous. Mr. Phil Trexler collected three near State Line. A woman near Roseland complained that moles were eating her tulip bulbs. This was surely the work of Pine-mice which followed the mole runways into the garden. Specimens: 3.

Ondatra zibethica zibethica (Linn.). Musk-rat. Very common. The draining of marshes has apparently not affected this species. They are numerous in every suitable lake and creek in the county including the St. Joseph River and the lakes on the Notre Dame campus. A farmer boy claimed to have caught over three hundred muskrats in Sousley Lake during the winter of 1931-32; he received sixty cents each for the skins. Specimens: 4.

Rattus norvegicus (Erxleben). House-rat. A well known house and store pest throughout the county. At Notre Dame

they have been found living wild on a small island in St. Joseph Lake. Specimens: 3.

Mus musculus musculus Linn. House-mouse. Also very common in buildings. In the fields west of the Notre Dame Stadium they are much more common than the native mice. Mr. Phil Trexler found them common in fields near State Line. Casual observation seems to indicate a slight difference in pelage between these wild forms and the house dwellers. Specimens: 5.

Zapus hudsonius hudsonius (Zimmerman). Jumping-mouse. Never very numerous; probably occurs over the entire county. My specimens were found in a brushy ravine and in a woodland meadow. Specimens: 3.

Erethizon dorsatum (Linn.). Porcupine. Hahn (1907) reports a porcupine killed a few years before in La Porte County; the specimen is supposed to be in the State Museum at Indianapolis. The porcupine has undoubtedly been exterminated for many years in St. Joseph County.

Sylvilagus floridanus mearnsii (Allen). Cotton-tail Rabbit. Common. Tularemia has not dampened the enthusiasm of local hunters—the distant report of the shotgun and the howl of the dog are as frequently heard during present seasons as before. The rabbits, while not numerous enough to excite attention, seem to be holding their own with the hunters. In South Bend, they live and breed in small empty lots with scant cover, within a mile and a half of the center of the city. Specimens: 2.

Cervus canadensis (Erxleben). Wapiti; American Elk. A pair of Elk antlers dragged up in a seine from the Kankakee River, this county, by Mr. H. F. Goppert of Walkerton about 1895, are considered by Lyon (1931) to be of recent age. Early histories of the county frequently mention the elk among the larger animals. Hahn (1909) mentions reports of elks within the state in 1829-30 which he believed reliable and which probably are the latest records.

Odocoileus virginianus (Boddaert). Virginia Deer. In Hawblitzel's Barber Shop, North Liberty, is the mounted head

of a buck deer which it is claimed was the last deer killed in St. Joseph County. It was shot about a mile south of North Liberty, in the early '80s. Hahn (1907) says that there were deer in the Kankakee Valley region (to the southwest of North Liberty) as late as 1891. Mr. Robert Geyer of North Liberty says that about 1840-45 his grandfather shot numerous deer from his house by moonlight—the deer straying into the clearing from the surrounding forest. Werich (1920) relates the story of a unique deer "drive" that took place in 1838 in an adjacent county, which will serve to illustrate the great abundance of deer in this general locality in pioneer days. Werich heard of the affair from one Mr. S. L. McFadden, who took part, as a boy of 12, with his father. The locality was Beaver Lake, in Newton County. In the lake was an island called Bogus Island, a quarter mile distant from the mainland at the nearest point. The water here was shallow in summer, and numerous animals besides deer moved over to the island from the shore. In the winter the ice was "slick and glary," presenting a poor running surface for the deer. In the hunt, the crowd was supposed to drive the deer off the island onto the ice, where they were at a disadvantage. Thus, the story goes, 25 men and boys and two women, armed with guns, clubs, tomahawks, pitch forks and corn knives killed 65 deer, 7 wolves, and 3 foxes—one of the deer having been laid low with a pitch fork!

Bison bison (Linn.). Buffalo. Father Hennepin, who accompanied La Salle in 1679 says that at the portage (German Township, St. Joseph County) they found a number of buffalo horns and the carcasses of those animals, and some canoes that the Indians had made of buffalo skin to cross the river with their load of meat (Shea Transl., p. 140.). He also says that the buffalo were here (Portage Prairie) so numerous that Miamis sometimes killed from one hundred to two hundred daily. He adds that they did this by setting fire to the grass, making a fiery corral, and thus forcing the buffalo to pass a given point, at which the Indians took their stand with bows and arrows (Shea Transl., p. 143.). Howard (1907) describes the park-like east bank of the St. Joseph River from the mouth to far beyond the limits of St. Joseph County as

having been once a great buffalo range, frequented especially by cows with calves. The early French hunters and traders called that part of this strip lying above and below the sites of South Bend and Mishawaka *parc aux vaches* (park of the cows), which term was corrupted to Parkovash by the later settlers. The name is commemorated in the present Parkovash street in South Bend.

Five Pleistocene mammals are known from St. Joseph County.

Castoroides ohioensis Foster, represented by a single incisor in the M.N.I.H.S. Engels, 1931.

Odocoileus virginianus (Boddaert). Antler fragment found associated with mammoth tooth by Mr. Burt Morris.

Symbos cavifrons (Leidy). Lyon, Proc. Ind. Acad. Sci. vol. 34, p. 34, fig. 1, 1926. M.N.I.H.S. fragment of skull.

Mammut americanus (Kerr). Hay, 1923, Nos. 46 and 47, p. 100. 2: U.N.D.

Elephas primigenius Blumenbach. Hay, 1923, No. 9, p. 139. U.N.D. Another Elephant tooth was found by Mr. Burt Morris on his farm near North Liberty in digging a drainage ditch, not more than six feet below surface. April, 1931. This tooth is illustrated in fig. 3.

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Fig. 1. Coyote, *Canis latrans*, killed by August Buysse and C. Sargent, March, 1923, in southwestern part of St. Joseph county.

Fig. 2. Virginia Deer, *Odocoileus virginianus*. Believed to be the last deer killed in St. Joseph County. Shot near North Liberty (1875-1880) this head is now in a barber shop at that place.

Fig. 3. *Elephas primigenius*. Four miles northwest of North Liberty, St. Joseph County, Indiana. Mr. Burt Morris, April, 1931. Not more than six feet below surface.

BIRDS OF JACKSON COUNTY, INDIANA

RAYMOND J. FLEETWOOD

Although there have been published papers on the birds of Brown and Monroe counties, there has been, as far as the writer is aware, no published list of the birds of the adjoining county—Jackson.

The following paper is based largely on the writer's own work in the county, covering a period of observations from 1930 to 1932. These observations have been largely confined to the northwestern part of the county, especially to the vicinity of Kurtz. Therefore this paper is not comprehensive of the avifauna of the county, but is offered as a preliminary list of the birds that have been observed and taken in the county. It includes brief notes as to occurrence, abundance, and migratory dates.

The arrangement and nomenclature follow the "Handbook of Birds of Eastern North America" by Frank M. Chapman; revised edition of 1932.

Jackson county is rather favorably situated in respect to summer and winter ranges, and as a migratory route, for a large number of birds. It lies on the northern boundary of the "Driftless Area" in the central part of southern Indiana about 65 miles south of Indianapolis. It is nearly square and generally level, except for the northwestern part and a range of "knobs" south of Brownstown, and has an area of 420 square miles. Jackson is, therefore, one of the largest counties in the state. Seymour, with a population of approximately 9000, is the largest town in the county.

The average elevation of the county is 675 feet. The maximum altitude of 940 feet is found in the western part of the county, and the minimum altitude of 490 feet in White River Valley at the southwestern corner of the county.

Originally most of the county was heavily wooded with a diversified growth of hardwoods, and the county is still interspersed with tracts of deciduous forests, especially in the hilly

parts. Here cultivation is not as extensive as it is in the eastern part of the county.

Jackson county is endowed with a number of streams, but does ont have any large marshes or lakes. The chief stream is the East Fork of White River, which flows in a southwesterly direction through the central part of the county. The Muscatutuck River, which forms most of the southern boundary of the county, empties into White River at a point six miles from the Lawrence county line. There are several bayous and small marshes along these principal streams. These are very attractive to water loving birds.

Salt Creek, with its numerous tributaries, drains the northwestern part of the county. This stream has carved deep valleys and ridges that extend in a northeasterly to southwesterly direction. These ridges, on an average, have an elevation of 280 feet above the valley floors and are mostly covered with second growth timber. Many fields in this area, that were once productive, have long since grown up to briars and bushes. Such places offer attractive nesting sites for birds.

Faunal List

Common Loon. *Gavia immer immer* (Brunnich). A very rare migrant. One record. A dead loon was found on White River near Medora, October, 1931. It was taken to a taxidermist at Seymour who mounted it.

Pied-Billed Grebe. *Podilymbus podiceps podiceps* (Linnaeus). A frequent migrant. The only record is that of a bird seen on Salt Creek at Maumee, April 1, 1932.

Great Blue Heron. *Ardea herodias herodias* (Linnaeus). A frequent to common migrant; usually seen along the banks of streams and ponds. Earliest spring record, March 21, 1932.

American Egret. *Casmerodius albus egretta* (Gmelin). Occasional summer visitor. Four records. Two were seen on Salt Creek at Houston, September, 20, 1930. A pair was seen on a pond two miles north of Kurtz, July 27, 1931. A single bird was seen on a pond near Kurtz, August 2, 1931. A single bird was seen on Dryden Pond near Brownstown, August 4, 1932.

Little Blue Heron. *Florida caerula caerula* (Linnaeus). An occasional summer visitor. One record. A flock of six birds was seen on Salt Creek near Houston, October 13, 1930.

Eastern Green Heron. *Butorides virescens virescens* (Linnaeus). A common summer resident along the streams and ponds of the county. Earliest spring records, April 19, 1931, and April 20, 1932. Latest fall record, September, 20, 1931.

Black-Crowned Night Heron. *Nycticorax nycticorax hoactli* (Gmelin). A spring and fall migrant. One record. Five were seen in some trees along White river near Brownstown, April 10, 1932.

American Bittern. *Botaurus lentiginosus* (Montagu). A fall and spring migrant. One record. A single bird was seen in a marsh two miles north of Kurtz, May 4, 1932.

Canada Goose. *Branta canadensis candensis* (Linnaeus). Fairly common as a migrant. Earliest spring record, March 17, 1932. Latest fall record, November 6, 1930.

Common Mallard. *Anas platyrhynchos platyrhynchos.* Linnaeus. This species is fairly common during the spring and fall migrations. One record. On Muddy Fork, near Kurtz.

Common Black Duck. *Anas rubripes tristis* Brewster. A common migrant. Four birds were seen on Salt Creek, near Kurtz, November 6, 1932.

American Pintail. *Dafila acuta tzitzihoa* (Vieillot). A migrant occasionally seen in the county. One record. A single bird was seen on a pond near Kurtz, January 27, 1931.

Green-Winged Teal. *Nettion carolinense* (Gmelin). A spring and fall migrant. One record. Two were seen in a dredge ditch near Cortland, April 16, 1932.

Lesser Scaup Duck. *Nyroca affinis* (Eyton). A spring and fall migrant. One record. A flock of six was seen on White River near Rockford, May 4, 1931.

Turkey Vulture. *Cathartes aura septentrionalis* Wied. These birds are plentiful here during the summer months and

it is not an uncommon thing to see them in companies of ten to forty gliding about in circling paths in the upper air. During the mild winter of 1931 and 1932 many of this species remained here.

Black Vulture. *Coragyps atratus atratus* (Meyer). A rare summer visitor. One record. Three birds were seen among turkey vultures feeding upon a carcass of a horse two miles north of Kurtz in May, 1927.

Sharp-Shinned Hawk. *Accipter velox velox* (Wilson). A rare permanent resident. This species, together with the following species, is very destructive to poultry.

Cooper's Hawk. *Accipter cooperi* (Bonaparte). A common permanent resident of the county. More numerous in the hilly sections.

Eastern Red-Tailed Hawk. *Buteo borealis borealis* (Gmelin). A common permanent resident usually observed flying around in circles high above wooded areas.

Northern Red-Shouldered Hawk. *Buteo lineatus lineatus* (Gmelin). A frequent permanent resident. They prefer the swampy lowlands to the high wooded areas.

Broad-Winged Hawk. *Buteo platypterus platypterus* (Vieillot). A fairly common summer resident that is found in the wooded areas of the county. Six birds were seen near Maumee, September 20, 1931.

American Rough-Legged Hawk. *Buteo lagopus sjohannis* (Gmelin). An occasional winter resident. One record. A bird was killed near Surprise, January 8, 1931. It was mounted by a taxidermist of Seymour and is now owned by a citizen of that city.

Southern Bald Eagle. *Haliaectus leucocephalus leucocephalus* (Linnaeus). A very rare visitor to the county. Two records. One is that of a bald eagle killed near Sauer's church, March 3, 1926. The other is that of a mature bald eagle observed by Buell Brown of Kurtz, October, 1931.

Marsh Hawk. *Circus hudsonius* (Linnaeus). A permanent resident of the lowlands. Often seen flying close to the ground. A nest found on the ground in a marsh near Kurtz, May 15, 1932, contained one infertile egg. There was evidence that the fledgelings had flown.

Eastern Sparrow Hawk. *Falco sparverius sparverius* Linnaeus. A common permanent resident of the open valleys.

Eastern Ruffled Grouse. *Bonasa umbellus umbellus* (Linnaeus). A permanent resident of the wooded areas of the northwestern part of the county. Although few are killed, they do not appear to be increasing.

Bob-White. *Colinus virginianus virginianus* (Linnaeus). A common permanent resident, seen and heard in all parts of the county.

Ring-Necked Pheasant. *Phasianus colchicus torquatus* (Gmelin). Within a few years this bird will be fairly common in the county, as many birds have been released on the State forest reserve at Brownstown.

Black Rail. *Creciscus jamaicensis stoddardi* Coale. A rare migrant. One record. One seen by the writer near Kurtz. Date unknown.

American Coot. *Fulica americana americana* Gmelin. A spring and fall migrant. Three records. A bird was killed on Salt Creek near Houston, April 12, 1931. A single bird was seen on White River near Rockford, May 4, 1931. A single bird was seen on Muddy Fork near Kurtz, April 27, 1932.

Semipalmated Plover. *Charadius semipalmatus* Bonaparte. A very rare migrant. Two records. Five birds were observed feeding around a pond near Kurtz, May 16, 1931. Two birds were seen at the same place May 17.

Killdeer. *Oxyechus vociferus vociferus* (Linnaeus). A very abundant summer resident. Many remained during the mild winter of 1931-32. The earliest nesting date is April 8, when a nest was found that contained three eggs.

Woodcock. *Philohela minor* (Gmelin). A frequent summer resident that is usually found in wooded areas. Earliest spring record, March 11, 1932, near Kurtz. Adults with fledgelings observed May 5.

Wilson's Snipe. *Capella delicata* (Ord). A frequent migrant. Earliest spring records, March 24, 1931, near Houston. One bird was seen March 12, 1932 near Kurtz. Nineteen birds were observed in a wet meadow a mile and a half north of Kurtz, April 9, 1932.

Upland Plover. *Bartramia longicauda* (Bechstein). A rare migrant. Earliest record, April 6, 1932. Four were seen in a meadow a mile and a half north of Kurtz. Latest spring record, April 20, 1932.

Spotted Sandpiper. *Actitis macularia* (Linnaeus). A summer resident along White River, and sometimes seen along the smaller streams of the county. One record. A single bird was observed on Salt Creek, near Houston, May 1, 1932.

Eastern Solitary Sandpiper. *Tringa solitaria solitaria* Wilson. Common spring and fall migrant. More often seen than the spotted sandpiper. Earliest record, April 19, 1931.

Greater Yellow-Legs. *Totanus melanoleucus* (Gmelin). A rare migrant. One record, May 4, 1931. Seen on White River near Rockford.

Lesser Yellow-Legs. *Totanus flavipes* (Gmelin). Rare migrant. Two records. One seen at Rockford, May 4, 1931. One seen near Kurtz, May 14, 1931.

Pectoral Sandpiper. *Pisobia melanota* (Vieillot). A frequent migrant. Spring migration from March 22 to April 20. One fall record, September 16, 1931.

Eastern Mourning Dove. *Zenaidura macroura carolinensis* (Linnaeus). An abundant permanent resident. Found in large flocks during the winter. A nest with two eggs was found May 1, 1932.

Yellow-Billed Cuckoo. *Coccyzus americanus americanus* (Linnaeus). A very common summer resident; more abun-

dant than the Black-Billed Cuckoo. Earliest record, May 8, 1932.

Black-Billed Cuckoo. *Coccyzus erythrophthalmus* (Wilson). A rare summer resident. One record. A single bird was seen near Kurtz, September 2, 1931.

Barn owl. *Tyto alba pratincola* (Bonaparte). A rare resident. William Taylor killed one in a cornfield near Kurtz, August 31, 1931. Another was seen on April 3, 1932, near Kurtz. A third was seen on May 14, 1932, near Kurtz.

Eastern Screech Owl. *Otus asio naevius* (Gmelin). A common permanent resident that appears to be decreasing.

Great Horned Owl. *Bubo virginianus virginianus* (Gmelin). A common permanent resident in the more wooded sections of the county. Less abundant than the Northern Barred Owl.

Northern Barred Owl. *Strix varia varia.* Barton. A common permanent resident in all parts of the county.

Short-Eared Owl. *Asio flammeus flammeus* (Pontoppidan). A rare winter resident. One record. One was killed sometime in December, 1930, near Houston.

Eastern Whip-poor-will. *Antrostomus vociferus vociferus* (Wilson). A very common summer resident. Earliest records, April 6, 1932, April 10, 1931, near Kurtz. Latest fall record, August 16, 1931.

Eastern Nighthawk. *Chordeides minor minor* (J. R. Forster). A common migrant. Spring migration, May 13 to May 28. Fall migration, August 16 to September 22. More numerous during the fall migration.

Chimney Swift. *Chaetura pelagica* (Linnaeus). A common summer resident. Earliest record, April 20, 1932. Latest fall record, October 11, 1930. A pair nested inside a wooden silo near Kurtz during the summer of 1931.

Ruby-Throated Hummingbird. *Archilochus colubris* (Linnaeus). A common summer resident. May 1 to September 2.

Eastern Belted Kingfisher. *Megaceryle alcyon alcyon*

(Linnaeus). A common summer resident. May be found along all the streams of the county. A nest was found two miles east of Houston during the summer of 1930.

Northern Flicker. *Colaptes auratus luteus* Bangs. A common permanent resident. Less common in winter.

Northern Pileated Woodpecker. *Ceophloeus pileatus abieticola* Bangs. A rare permanent resident that is found in the wooded sections of the county, especially in the northwestern part. This species appears to be increasing. A pair of these birds was observed near Maumee, September 12, 1932.

Red-Bellied Woodpecker. *Centurus carolinus* (Linnaeus). A common permanent resident. The most common woodpecker to be found in the county, excepting the Northern Downy Woodpecker, during winter.

Red-Headed Woodpecker. *Melanerpes erythrocephalus* (Linnaeus). A common summer resident, especially in those parts of the county that have many telephone poles. A rather rare winter resident.

Yellow-Bellied Sapsucker. *Sphyrapicus varius varius* (Linnaeus). A rare migrant. Two early records, April 9, 1931 and March 31, 1932, near Houston.

Eastern Hairy Woodpecker. *Dryobates villosus villosus* (Linnaeus). A permanent resident. Less abundant than the Northern Downy Woodpecker.

Northern Downy Woodpecker. *Dryobates pubescens medianus* (Swainson). A permanent resident, common in woodlands, orchards, and parks.

Kingbird. *Tyrannus tyrannus* (Linnaeus). A common summer resident. April 22 to August 23.

Northern Crested Flycatcher. *Myiarchus crinitus boreus* Bangs. A common summer resident. April 26 to September 2.

Eastern Phoebe. *Sayornis phoebe* (Latham). A very common summer resident. Usually nesting among buildings, bridges, or cliffs.

Yellow-Bellied Flycatcher. *Empidonax flaviventris* (W. M. and S. F. Baird). A rare migrant. Three records of this species as follows: May 20, 1931; May 28, 1931; and May 1, 1932. Two were seen on the latter date near Houston.

Acadian Flycatcher. *Empidonax virescens* (Vieillot). A fairly common summer resident of thickly wooded hollows. Earliest spring record, May 8, 1932.

Least Flycatcher. *Empidonax minimus* (W. M. and S. F. Baird). A rare migrant. Earliest spring record, May 9, 1932.

Eastern Wood Pewee. *Myiochanes virens* (Linnaeus). Abundant summer resident. May 8, to September 22.

Prairie Horned Lark. *Otocoris alpestris praticola* Henshaw. A common permanent resident that occurs in fields of the county. More abundant in winter. Mr. Lowery Fish, of Norman Station, while sowing clover seed in his wheat field on February 25, 1931, found on the ground, a nest that contained one infertile egg and two young birds which were partially feathered. The nest was destroyed by water from a melting snow a few days later.

Tree Swallow. *Iridoprocne bicolor* (Vieillot). A rare migrant. Earliest record, April 11, 1932, near Kurtz.

Bank Swallow. *Riparia riparia riparia* (Linnaeus). A common summer resident, especially along White River.

Rough-Winged Swallow. *Stelgidpteryx ruficollis serripennis* (Audubon). A common summer resident.

Barn Swallow. *Hirundo erythrogaster* Boddaert. A common summer resident. April 9 to September 16. Many pairs nest near Houston.

Northern Cliff Swallow. *Petrochelidon albifrons albifrons* Rafinesque. A very rare migrant. Formerly nested in abundance within the county. Three records. May 12, 1932, near Kurtz. Three birds were seen flying over a pond. May 17, 1932, near Kurtz. Two birds were observed on a telephone wire. May 22, 1932, near Kurtz. A single bird was seen flying over a meadow.

Purple Martin. *Progne subis subis* (Linnaeus). A very common summer resident that may be found on nearly every farm in the county that has a martin house. March 23 to August 30.

Blue Jay. *Cyanocitta cristata cristata* (Linnaeus). A common permanent resident.

Eastern Crow. *Corvus brachyrhynchos brachyrhynchus* Brehm. An abundant permanent resident. More common in summer than in winter.

Carolina Chickadee. *Penthestes carolinensis carolinensis* (Audubon). A common permanent resident.

Tufted Titmouse. *Baeolophus bicolor* (Linnaeus). An abundant permanent resident.

Northern White-Breasted Nuthatch. *Sitta carolinensis carolinensis* Latham. A common permanent resident.

Red-Breasted Nuthatch. *Sitta canadensis* Linnaeus. A common migrant. February 24 to April 19.

Brown Creeper. *Certhia familiaris americana* Bonaparte. A common winter resident. Latest spring record, April 26, 1932.

House Wren. *Troglodytes aedon aedon* Vieillot. A common summer resident, especially in White River Valley. I have never observed this species in the hilly sections of the county. Here its place is taken by Bewick's Wren.

Eastern Winter Wren. *Nannus hiemalus hiemalus* (Vieillot). A common winter resident. More abundant in early spring. Latest spring record, April 27, 1932.

Bewick's Wren. *Thryomanes bewicki bewicki* (Audubon). A common summer resident, usually found around dwellings. Both the House Wren and this species are found breeding in White River Valley. March 22 to October 11.

Carolina Wren. *Thryothorus ludovicianas ludovicianus* (Latham). A common permanent resident. Prefers tangles and fallen tree tops.

Long-Billed Marsh Wren. *Telmatodytes palustris palustris* (Wilson). A common fall migrant that may be observed in swamps from August 1 to September 20.

Mockingbird. *Mimus polyglottos polyglottos* (Linnaeus). A rare summer resident. Earliest record, May 4, 1932, near Kurtz. Nest found in Red Haw tree, June 2, 1932. Contained two fledgelings.

Catbird. *Dumetella carolinensis* (Linnaeus). An abundant summer resident, April 19 to October 5.

Brown Thrasher. *Toxostoma rufum* (Linnaeus). A common summer resident. A nest found in a wild crab tree, May 1, 1932, contained four eggs. March 30 to September 28.

Eastern Robin. *Turdus migratorius migratorius* Linnaeus. An abundant summer resident, but a rare winter resident.

Wood Thrush. *Hylocichla mustelina* (Gmelin). A common summer resident. Earliest spring record, April 20, 1931.

Eastern Hermit Thrush. *Hylocichla guttata faxoni* Bangs and Penard. A rare migrant, usually found in second growth and open woods. Earliest record, March 5, 1932.

Olive-Backed Thrush. *Hylocichla ustulata swainsoni* (Tschudi). A common migrant. Recorded May 8 and May 9, 1932.

Veery. *Hylocichla fuscescens fuscescens* (Stephens). A common migrant. Rarer in the fall. May 9 to May 19 and September 6 to September 16.

Eastern Bluebird. *Sialia sealis sialis* (Linnaeus). A common permanent resident.

Blue-Gray Gnatcatcher. *Polioptila caerulea caerulea* (Linnaeus). A common summer resident. April 6 to September 16. A nest containing four eggs was found in a Black Willow tree along the bank of Muddy Fork, May 15, 1932. While I observed the nest a gnatcatcher came and took a mouthful of material from the nest and flew away.

Golden-Crowned Kinglet. *Regulus satrapa satrapa* Lichtenstein. An abundant migrant and a common winter resident. October 24 to April 17.

Eastern Ruby-Crowned Kinglet. *Corthylio calendula calendula* (Linnaeus). A common migrant and a rare winter resident. April 9 to May 1. No fall records.

American Pipit. *Anthus spinoletta rubescens* (Turnstall). A common winter visitor. Some large flocks estimated at one hundred fifty individuals. This species prefers cultivated or open fields. March 6 to May 9.

Cedar Waxwing. *Bombycilla cedrorum* Vieillot. This bird is frequently seen throughout the year. Not uncommon during the winter.

Migrant Shrike. *Lanius ludovicianus migrans* W. Palmer. A rare permanent resident. Four were seen near Kurtz, March 4, 1932. One nesting record in an orchard near Kurtz. Date not known.

Starling. *Sturnus vulgaris vulgaris* Linnaeus. A common permanent resident since 1931. My first record for the county is January 4, 1931. A flock of twenty-five was observed near Kurtz. One pair nested in a hole in an apple tree near Kurtz, and another in a building in Houston during the summer of 1931.

White-Eyed Vireo. *Vireo griseus griseus* (Boddaert). A common summer resident that is more often found along the wooded banks of streams and in thickets. April 26 to September 20.

Yellow-Throated Vireo. *Vireo flavifrons* Vieillot. A rare summer resident. More common as a migrant. Earliest spring record, April 26, 1932.

Blue-Headed Vireo. *Vireo solitarius solitarius* (Wilson). A rare migrant. Two records. A single bird was seen on April 21, and a single bird was seen on April 29, both in 1932, on Muddy Fork near Kurtz.

Red-Eyed Vireo. *Vireo olivaceus* (Linnaeus). An abundant summer resident. April 26 to September 20.

Eastern Warbling Vireo. *Vireo gilvus gilvus* (Vieillot). A common summer resident. April 26 to September 6.

Black and White Warbler. *Mniotilta varia* (Linnaeus). A common migrant and a rare summer resident. A fledgeling was caught and banded near Kurtz, May 31, 1931. April 9 to September 22.

Worm-Eating Warbler. *Helmitheros vermivorus* (Gmelin). A common migrant and a frequent summer resident. Earliest record, April 30, 1932.

Golden-Winged Warbler. *Vermivora chrysoptera* (Linnaeus). A very rare migrant. Seen for the first time in the hills between Cornett's Grove and Houston, on May 8, 1932.

Blue-Winged Warbler. *Vermivora pinus* (Linnaeus). A common migrant. April 28 to June 23. Most often found in brushy fields. It is likely that birds present at the latter date are breeding but no nests have been found. A bird observed June 23 will substantiate this belief. My records show that this species arrived on April 28 for the year 1931 and 1932.

Tennessee Warbler. *Vermivora peregrina* (Wilson). An abundant migrant. May 8 to May 28. No fall records.

Nashville Warbler. *Vermivora ruficapilla ruficapilla* (Wilson). A rare migrant. Two records. One seen September 20, 1931, near Maumee. One seen May 8, 1932 in the woods between Cornett's Grove and Houston.

Eastern Yellow Warbler. *Dendroica aestiva aestiva* (Gmelin). A common summer resident. Earliest record, April 18. A nest was found, May 19, 1932, twelve feet from the ground, in a small sycamore by the road, a mile north of Kurtz.

Magnolia Warbler. *Dendroica magnolia* (Wilson). A fairly common migrant. May 8 to May 24, and September 25 to October 14.

Black-Throated Blue Warbler. *Dendroica caerulescens caerulescens* (Gmelin). A rare migrant. One record, May 8, 1932. A single male was seen in a hollow near Kurtz.

Myrtle Warbler. *Dendroica coronata* (Linnaeus). An abundant migrant. April 5 to May 17.

Black-Throated Green Warbler. *Dendroica virens virens* (Gmelin). A common migrant. More abundant in the fall. May 1 to May 11, and August 30 to October 12.

Cerulean Warbler. *Dendroica cerulea* (Wilson). A common migrant and possibly a summer resident. April 27 to June 21.

Blackburnian Warbler. *Dendroica fusca* (Müller). A frequent to common migrant. May 8 to May 24. One fall record, September 17, 1932; two were seen.

Sycamore Warbler. *Dendroica dominica albilora* Ridgway. A very rare migrant. One record, April 19, 1931. A single bird was observed in the top of a tree on Muddy Fork near the Cornett's Grove bridge.

Chestnut-Sided Warbler. *Dendroica pensylvanica* (Linnaeus). A common migrant. May 8 to May 31, and September 30 to October 5.

Bay-Breasted Warbler. *Dendroica castanea* (Wilson). A rare migrant. May 8 to May 11. Not recorded during the fall migration.

Black-Poll Warbler. *Dendroica striata* (J. R. Forster). A common migrant. May 9 to May 31.

Northern Pine Warbler. *Dendroica pinus pinus* (Wilson). A rare migrant. One record, September 28, 1930. Several were seen in a Red Cedar tree near Houston.

Prairie Warbler. *Dendroica discolor discolor* (Vieillot). A rare migrant. Four records. One was seen April 29, 1931, near Houston. One was seen May 1, 8, and 26, 1932 in the vicinity of Cornett's Grove. These birds may breed in the county.

Palm Warbler. *Dendroica palmarum palmarum* (Gmelin). A common migrant that is often observed near dwellings. April 28 to May 17, and September 25 to October 9.

Ovenbird. *Seiurus aurocapillus* (Linnaeus). A common summer resident, but more abundant as a migrant. Earliest spring record, April 20, 1931.

Louisiana Water-Thrush. *Seiurus motacilla* (Vieillot). A common summer resident that may be found along the streams of the county. April 12 to September 20.

Kentucky Warbler. *Oporornis formosus* (Wilson). A frequent to common summer resident. Earliest record, May 8. Several birds were seen near Kurtz. A nest was found May 31, 1931, contained three eggs of this species and one larger egg of the cowbird.

Mourning Warbler. *Oporornis philadelphia* (Wilson). A rare migrant. Two records. Four birds were seen May 17, 1931, in a briar patch near Kurtz. One was seen at the same place May 24, 1931.

Northern Yellow-Throat. *Goethlypis trichas brachidactyla* (Swainson). An abundant summer resident. Prefers thickets in lowlands. Earliest spring record, April 25, 1932.

Yellow-Breasted Chat. *Icteria virens virens* (Linnaeus). A common summer resident, commonly found in thickets and partial clearings. April 30 to September 6.

Hooded Warbler. *Wilsonia citrina* (Boddaert). A common migrant and a possible rare summer resident. May 1 to June 12. One fall record, October 14, 1930. A single bird was seen on a wooded hillside near Houston.

Wilson's Warbler. *Wilsonia pusilla pusilla* (Wilson). A rare migrant. Two records. A bird was seen in a thicket north of Kurtz, May 17 and 24, and September 2, 1931. One bird was seen May 17, 1932.

Canada Warbler. *Wilsonia canadensis* (Linnaeus). A frequent migrant. Five records, all for 1931; May 17, 19, 20, and 24, and August 23. The birds were seen near Kurtz.

American Redstart. *Setophaga ruticilla* (Linnaeus). A rare migrant. Five records. Birds were seen May 17 and May 24, and September 2 and September 20, 1931. A single male was seen near Kurtz, May 15, 1932.

English Sparrow. *Passer domesticus domesticus* (Linnaeus. Very abundant at all times of the year.

Bobolink. *Dolichonyx oryzivorus* (Linnaeus). A common migrant seen in large flocks in the spring, roving over hills. Rarely seen on the ground during the fall migration. April 23 to May 17, and August 1 to September 23.

Eastern Meadowlark. *Sturnella magna magna* (Linnaeus). An bundant permanent resident. A nest found May 4, 1932, contained one egg. An additional egg was laid on consecutive days until five had been deposited in the nest. The nest was found destroyed May 9, preventing further observation.

Eastern Red-Winged Blackbird. *Agelaius phoeniceus phoeniceus* (Linnaeus). A common summer resident of swamps and marshes, and a possible permanent resident, as I have records for November 1 and 28.

Orchard Oriole. *Icterus spurius* (Linnaeus). A frequent to common summer resident. Earliest spring record, May 1, 1932.

Baltimore Oriole. *Icterus galbula* (Linnaeus). A common summer resident in the vicinity of towns in White River Valley. I have never found it common in the hilly sections of the county. Earliest spring record, April 30, 1932. One was seen near Kurtz.

Rusty Blackbird. *Euphagus carolinus* (Müller). An abundant migrant. Often seen in large fields. March 8 to April 19.

Bronzed Grackle. *Quiscalus quiscalus aeneus* Ridgway. A common summer resident and a possible permanent resident during mild winters as the winter of 1930-31. Many were observed during that winter.

Cowbird. *Molothrus ater ater* (Boddaert). An abundant

summer resident. Occasionally seen in winter. The greater numbers do not come in migration until the first week in April.

Scarlet Tanager. *Piranga erythromelas* Vieillot. A common resident. Earliest spring record, April 26, 1932. One was seen in a wood near Kurtz. A nesting bird was found May 21.

Summer Tanager. *Piranga rubra rubra* (Linnaeus). A common summer resident. Earliest record, May 3, 1932. One was seen near Kurtz.

Eastern Cardinal. *Richmondena cardinalis cardinalis* (Linnaeus). An abundant permanent resident. A nest containing three eggs was found May 11.

Rose-Breasted Grosbeak. *Hedymeles ludovicianus* (Linnaeus). A common migrant. May 8 to May 15, and September 18 to October 2.

Indigo Bunting. *Passerina cyanea* (Linnaeus). A common summer resident. April 22 to September 23.

Dickcissel. *Spiza americana* (Gmelin). A rare summer resident. My first record for the county was July 22, 1931. I saw a single bird in a field near Cornett's Grove. A nest found near the Cornett's Grove bridge, August 9, 1931, contained four eggs. This nest was later destroyed by grazing cattle.

Eastern Purple Finch. *Carpodacus purpureus purpureus* (Gmelin). A common migrant. February 22 to April 28. Very numerous during the spring of 1932. Two records for 1931; March 17 and March 18. A single bird was seen on each date.

Eastern Goldfinch. *Spinus tristis tristis* (Linnaeus). An abundant summer resident. Often seen in large flocks during the winter feeding in weed patches.

Red-Eyed Towhee. *Pipilo erythrophthalmus erythrophthalmus* (Linnaeus). A common permanent resident, but less

common in winter. A nest found on the ground, May 30, 1931, contained four young birds.

Eastern Savannah Sparrow. *Passerculus sandwichensis savanna* (Wilson). A common migrant. Often seen slipping through the grass in wet meadows. April 3 to April 15.

Eastern Grasshopper Sparrow. *Ammodramus savannarum australis* Maynard. A fairly common summer resident. April 16 to August 24.

Eastern Vesper Sparrow. *Pooecetes gramineus gramineus* (Gmelin). A common summer resident. March 31 to November 14. A nest found June 2, 1932, contained four young birds. This nest was in a meadow and within six feet of a meadowlark's nest.

Bachman's Sparrow. *Aimophila aestivalis bachmani* (Audubon). A rare summer resident. Found in uneven pastures where briars and rosebushes are plentiful. Three records for 1932. One was seen on the state forest reserve at Brownstown, April 10. One was seen near Maumee, April 17. One was seen near Cornett's Grove, May 8.

Slate-Colored Junco. *Junco hyemalis hyemalis* (Linnaeus). An abundant winter resident. October 1 to April 23.

Eastern Tree Sparrow. *Spizella arborea arborea* (Wilson). An abundant winter resident; usually found feeding in weed patches. October 14 to April 10.

Eastern Chipping Sparrow. *Spizella passerina passerina* (Bechstein). A common summer resident. March 31 to October 1. A nest found in a rosebush, May 6, contained two eggs.

Field Sparrow. *Spizella pusilla pusilla* (Wilson). An abundant summer resident that prefers weedy fields. February 18 to November 6.

White-Crowned Sparrow. *Zonotrichia leucophrys leucophrys* (Forster). A fairly common migrant. May 4 to May 11. One fall record, October 19, 1931. Five birds were observed near Kurtz.

White-Throated Sparrow. *Zonotrichia albicollis* (Gmelin). An abundant migrant. More numerous in the fall. April 19 to May 17, and October 11 to October 26.

Fox Sparrow. *Passerella iliaca iliaca* (Merrem). An abundant migrant. Commonly found in thickets and along creek banks. March 5 to April 19, and October 26 to December 21.

Swamp Sparrow. *Melospiza georgiana* (Latham). A common migrant, usually found in swamps and wet meadows. April 17 to May 1. No fall records.

Eastern Song Sparrow. *Melospiza melodia melodia* (Wilson). An abundant permanent resident. Not uncommon in winter.

Snow Bunting. *Plectrophena nivalis nivalis* (Linnaeus). A rare winter visitor. One record. Six birds were observed in February, 1931, near Kurtz.

KURTZ, INDIANA.

THE GENETIC AND PHYLOGENETIC SIGNIFICANCE OF THE PRESENCE OF A THIRD UPPER MOLAR IN A MODERN DOG.

ALBERT ELMER WOOD AND HORACE ELMER WOOD, II.

All living species of *Canis* and most other members of the Canidae, both living and fossil, have a normal dental formula of I 3/3, C 1/1, P 4/4, M 2/3, differing from primitive placentals and from some of the earlier fossil canids in having lost their third upper molars. It is reasonably certain that M 3/ was normally absent in the ancestors of the modern canids by the end, and, rather probably, before the middle, of the Oligocene. Occasionally, however, a third upper molar may be present, on one or both sides, in a modern dog. Instances are cited by Van der Hoeven (1856), Hensel (1879), Nehring (1882), Mivart (1890*b*), Windle and Humphreys (1890), Bateson (1892 and 1894), Thomas (1904), Hilzheimer (1906) and Agduhr (1921). Apparently, the only published illustrations of a canid M 3/ (*Otocyon* and fossil dogs excepted) show a skull of *Canis azarae*, figured, very sketchily, by Van der Hoeven (1856), and, less unsatisfactorily, by Bateson (1892, reprinted 1894). A skull of *Canis familiaris*, breed unknown, with this tooth present on the right side (fig. 1), in the authors' possession, led to this study.

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The skull is that of a good-sized, rather long-headed dog, being 231 mm. long, 102.5 mm. broad, 64 mm. deep without the jaw; with the jaw, it is 88 mm. deep. The third molar erupted out of alignment, the protocone being rotated back-

ward almost forty-five degrees.[1] The tooth is subtriangular, with the transverse axis the longer. However, due to the rotation of the tooth, the apex is directed considerably to the rear, instead of mediad. The protocone is well developed. The most prominent cusp, at the antero-external corner, seems to be the paracone. Posterior to it, a much smaller and lower cusp represents the reduced metacone. A small

Fig. 1. *Canis familiaris*, recent. x 1. Left P 4/—M 3/.

Fig. 2. *Daphaenus hartshornianus*, middle Oligocene, Colorado, x 1. Amer. Mus. Nat. Hist. No. 6811. Left P 4/—M 3/.

Fig. 3. *Miacis medius*, Lower Washakie (middle Eocene), Wyoming, x 2. Amer. Mus. Nat. Hist. No. 13137, type, after Matthew (1909). Left P 4/—M 3/.

and rather indistinct protoconule intervenes between the paracone and the protocone. The median valley runs anteroposteriorly and opens freely at both ends. There is a well developed anterior cingulum, a faint posterior cingulum, and a trace of an external cingulum between the paracone and metacone. Due to the abnormal position of M 3/ in the jaw, the third right lower molar bit outside the third upper molar,

[1] In fig. 1, this tooth has been placed in a more normal position with reference to the other teeth.

the exact reverse of normal occlusion, producing considerable wear, of an anomalous character, on the external face of the paracone of M 3/. M 3/ has three roots, under the protocone, paracone and metacone, respectively, differing from the dogs mentioned by Bateson (1894) who found only a single root on all the extra molars he observed. Hence, this tooth offers a closer resemblance to the ancestral condition in the Eocene or Oligocene. This M 3/ is generally similar to a normal M 2/, the chief difference, other than size, being that in the former the metacone is markedly reduced in size, whereas in the latter the paracone and metacone are subequal. The resemblance is closer between M 3/ and that of various fossil dogs and of Eocene miacid creodonts. As a further anomaly, this skull possesses five right upper premolars, the extra one being interpreted as a retained first deciduous premolar.

A third upper molar of this general type is present in *Miacis*, a Middle Eocene creodont (fig. 3 and Matthew, 1909, p. 364), and in the following fossil canids: *Daphaenus hartshornianus* (fig. 2; also figured, less accurately, in Cope, 1885, Pl. LXX, fig. 12); *D. vetus* (Leidy, 1869, Pl. I, figs. 5-6), both from the Middle Oligocene; *Paradaphaenus cuspigerus*, from the uppermost Oligocene John Day Formation, which is, perhaps, the most similar form, morphologically, to the modern case in question; *Daphaenodon superbus*, from the Lower Miocene (Peterson, 1910, Pl. LXXV); and in various species of *Amphicyon* from the later Miocene and early Pliocene (Wortman, 1901, figs. A and B). All of these canids are on an evolutionary line progressively divergent from living dogs; even *Daphaenus* is now usually not regarded as ancestral to any of the living canids (Matthew, 1924 and 1930). Matthew (1930) regards the creodont *Miacis* from the Bridger Eocene as close to the line which leads to the Canidae. In any case, the structure of its third molar illustrates a stage through which the ancestors of the living dogs must have passed in the process of reduction and final loss of the tooth. *Paradaphaenus* shows a stage of reduction very similar to the present instance, in an independent line of canid evolution, and probably closely resembles the conditions found in the third upper molars of the earliest canids ancestral to the living dogs. In

Daphaenus, *Daphaenodon* and *Amphicyon*, the reduction of the third molar has proceeded somewhat further than in the other two genera mentioned, or than in the skull of the modern dog, since there are but two cusps left—a single external cusp, presumably the paracone, and the protocone, median to it.

There seem to be four conceivable explanations of extra teeth in general—(1) mechanical splitting of a tooth germ; (2) retention of a deciduous tooth; (3) mutation producing a new tooth; (any of these three might be called "reduplication") and (4) reversion to an ancestral condition, which might be due to the occasional appearance of the gene governing the tooth, which had been almost, but not quite, eliminated from the general population by adverse natural selection; to a reverse mutation; to the recombination of multiple factors; or to some other genetic mechanism.

If the presence of an extra tooth were due to a splitting of the tooth germ, one would assume, both *a priori*, and from experiments in splitting the anlagen of other organs, that in such a case either the two teeth would have the same pattern, that they would be mirror images of each other, or that the two together would approximate the pattern of the original tooth. None of these is the case with regard to the tooth in question, which, if developed in this manner, must have been split from the germ of M 2/. Agduhr (1921) interprets extra teeth in this way, but definitely recognizable cases of tooth splitting are quite rare, Bateson (1894) mentioning but four, of which three are only partial division. Mivart (1890*b*) and Bateson (1894) figure a third lower molar occurring as five denticles. A few cases have been observed in other forms (cat, walrus), and the numerous homodont teeth of porpoises, armadillos and *Myrmecobius* have often been explained on this basis.

Much more common than tooth splitting is the retention of a deciduous tooth, Bateson, for example, mentioning about forty cases in nearly six hundred skulls. Most extra premolars (including the one in the skull in question) seem to result from this process. Anderson (1901) cites a dog with four incisors behind the regular set, which he suggests were

permanent teeth forced out of position by the retained deciduous ones. The instances of extra incisors mentioned by Mivart (1890*b*), Bateson (1894), Kunstler and Chaine (1906) and Lambe (1907) are most readily explained in this way. However, this cannot account for the presence of the tooth under consideration. Its size and shape are not those of a deciduous premolar, and, instead of being at the anterior end of the molar series, as a retained deciduous tooth would be, it is at the posterior end.

It seems unlikely that this molar is the result of a mutation of a new type (i. e., a mutant of a gene which had not previously controlled this tooth), because of the extreme improbability, if such were the case, of the end product showing such close similarity to the ancestral condition.

Hence by elimination, as well as by the close resemblance to the teeth of some of its ancestors or collateral ancestors, it seems that a reversion (using the term in a purely descriptive sense) of some sort is the only reasonable explanation of the presence of this tooth in this animal. Huxley (1880) regarded M 3/ and, apparently, M /4, also, as reversions, by analogy with *Otocyon*, in spite of the lack of any fossil placental ancestor with four lower molars; and Tims (1896) carried the idea still further by interpreting extra teeth, to any number, as reversions, to Mesozoic ancestors if necessary. In the past, the presence of M 3/4 in *Otocyon* and the sporadic occurrence of M 3/ in other modern dogs have been interpreted as part of the same problem; but it is quite certain that two distinct processes are represented. The virtual identity in pattern and size of M 1/ with M 2/ and of M /1 with M /2 in *Otocyon* (Miller, 1909, Pl. LXII and Hollister, 1918, Pl. XXIII) is almost conclusive evidence that this represents "reduplication" of the first or third type listed above.

If, then, fig. 1 represents a case of reversion, what can be the mechanism involved? Obviously, it is impossible to determine the exact course which has been followed in this or similar cases without more evidence than is available, particularly as to the pedigree of the animals in question. However, it

seems worth while to evaluate the various mechanisms that could be involved.

The first thing to be explained is why M 3/ is sometimes present on one side, sometimes on the other, and occasionally on both. Is this variation genetic or environmental? If genetic, one must assume that the teeth of the two sides are inherited independently, which is highly improbable. There is no evidence, in any animal, that there are two independent sets of genes, each governing one side of the animal. On the contrary, it is well established that when a single gene is mutated, as that governing white eyes in *Drosophila*, the effect is the same on both sides of the body, unless influenced by environmental factors. Hence, any difference between the teeth of the two sides should be environmental. It may be assumed that the gene governing the tooth is not strong enough in its effect to counteract adverse environmental conditions — as crowding, due either to large teeth or a small jaw, malformation of the jaw, characteristics of the jaw bone, state of development of the other teeth when M 3/ begins to develop, etc. —and that in those cases where the environment was sufficiently disadvantageous, although the germ plasm would contain the potentialities for the development of the tooth, and though, perhaps, it might begin its development, yet it would be suppressed on one side or the other before it had erupted.[2]

Of the genetic explanations for the presence of the tooth, one of the most obvious postulates a mutation which caused the loss of the third upper molar. This assumption by itself cannot fully satisfy the demands of the present problem, as, if the mutant were a dominant, the homozygous recessives (the animals which had an M 3/) should appear as a quarter of the population, and if the mutant were a recessive (as is more likely, as most mutants which have been studied are recessives), the wild type (i. e., M 3/) would be expected to show itself in three quarters of the population. Bateson (1894), however, out of 1672 specimens of wild and domestic

[2] Stockard (1930) reached the same conclusion with regard to the presence of a hallux on only one side in the dog.

dogs found but thirty cases with an extra third upper molar.[3] Hilzheimer (1906) records 5 instances of extra upper molars in 400 individuals, making a total of 35 cases out of 2072 animals, giving a ratio of occurrence of 1:59.2. Obviously, this ratio is very far from either of those predicted above. If, however, the mutant gene had an effect on some other part of the body, or on some physiological process within the body, which was of survival value; or if the mutant were closely linked to another gene which had such an effect of survival value, then there would be a tendency for the animals homozygous for the mutant to survive, whereas there would be a negative selection of all the animals which carried the wild type gene (i. e., that for M 3/).[4] This would tend in time to cause the almost complete disappearance of the wild type gene, which would survive only in a few scattered individuals, the length of time involved depending on the rate at which adverse natural selection took place.

This selection might have gone on long enough to cause the total extinction of the wild type gene. Just as from the wild type, so from the mutated gene, mutations occur in all directions. That is, as Muller (1930) has shown, a gene is as likely to mutate back to the type from which it was derived, as in any other direction. If this explanation is correct, the fact that the animals involved have reached their full growth seems to indicate: either (1) that the effect of survival value has remained unchanged by the remutation of the gene; or (2) that the rate of selection is so slow as not to be apparent in one generation; or (3) that this factor is of no survival value at the present day; or (4) that it does not become effective until fairly late in life, as, for example, during the reproductive period. This explanation, as a backward

[3] Four cases among 452 wild dogs; 26 cases among 1,220 domestic dogs. This gives an incidence of occurrence among domestic dogs about twice that in wild dogs, which suggests that there is an associated factor of selective value, but that the rate of selection is reduced among domestic dogs.

[4] Due to the rarity of complete dominance, the heterozygote, even if the mutant were a dominant, would probably be at somewhat of a disadvantage, and would hence be somewhat negatively selected.

mutation, does not appear to be a very satisfactory one, at first sight, as the third upper molar occurs so often that it is very improbable that each individual possessing it is an example of mutation, and it is unlikely that the dogs, of all the many varieties in which this tooth has been observed, are closely related. The number of dogs with M /4 cited by Bateson (1894) is essentially the same as that of those with M 3/ (29 as opposed to 30). As the primitive placental type has only three molars, this obviously cannot be a reversion to the condition in any placental ancestor. *Otocyon* has perhaps descended from a form in which the germs of M 1/ and M /1 each split to form two teeth, as may be seen from the great similarity in pattern of M 1/ to M 2/ and M /1 to M /2 (see Miller, 1909, Pl. LXII or Hollister, 1918, Pl. XXIII). However, the dogs mentioned by Bateson will not fall into this category of tooth splitting, nor of retained deciduous teeth, for the same reasons as for M 3/. This leaves only the possibility of mutation to explain these lower teeth. Could they not have been caused by a mutated gene which has become fairly widely scattered among the canids, so that the recombination of recessive allelomorphs in one or more genes is fairly common? On this basis, M 3/ could be due to the recombination of recessive allelomorphs from a reverse mutation (or a series of reverse mutations, perhaps involving three genes) which took place at a sufficiently remote date so that the recessive allelomorphs are at present fairly widely distributed.

It is possible, though unlikely, that the mutant causing the loss of the tooth, if there were only one, might be lost at some time during the mitosis of a germ cell, particularly if it were situated near one end of a chromosome, the broken-off fragment becoming attached to the homologous chromosome entering the other daughter cell, in this way causing the tooth to reappear in the zygote receiving the reduced chromosome. But, as in the case of mutation, the rate necessary to explain the data (once in every 59 animals) is too high to be found in nature, and this explanation would be satisfactory only if the transposal of the chromosome fragment had taken place some time ago, and if the animals in which the chromosomes were of this type had now become fairly widely distributed.

The loss of the tooth was probably not brought about by the development of a single mutation with an effect of survival value or linked with another gene of survival value and the subsequent elimination of the wild type forms through natural selection; nor by a backward mutation; nor by a chromosomal mutation. It seems most likely that the loss was brought about by the formation, through several mutations, of a series of multiple factors, the presence of any one of which would be capable of preventing (or inhibiting) the appearance of the tooth.[5] When all these mutants were absent in a given animal, and only the nonmutated genes could affect the phenotype, the tooth would be present. Naturally, the more genes were involved, the rarer would be the reappearance of the tooth. And again, its frequency would vary depending on whether or not natural selection had been working in favor of the mutated forms. If some of the mutants were dominant and some recessive, some positively selected and others negatively, the genetic situation would be sufficiently complex so that one could easily obtain any desired result. The ratio derived from Bateson's and Hilzheimer's figures (1:59.2) suggests that there were three dominant mutations, any one of which causes the absence of M 3/. This should, theoretically, give a ratio of 1:64.

The occasional presence of M 3/ in modern dogs is of interest in connection with a frequent interpretation of the so-called "law" of the irreversibility of evolution. Osborn (1930) says "Through change of function nature may transform an organ but it can never restore a single lost part, whether a lost tooth, a lost digit, a lost ankle bone or rib, a lost tendon or nerve." As has just been shown, in this case, at least, a lost tooth *has* been restored. The same point has been made by Stockard (1930) in interpreting the reappearance of lost toes in guinea-pigs and dogs, The reappearance of long-lost upper incisors or canines in a calf (Bradley, 1902) is another example. These instances seem to indicate that "irreversibility of evolution" should not be dignified by the term "law." If the "law"

[5] Stockard (1930) concludes that this is the most likely explanation of the almost universal absence of the hallux in canids.

can be pressed too far in regard to the presence or absence of a definite, specialized structure, there is an even greater danger in making inferences with regard to simple changes of proportions, such as differences in limb proportion of men as compared with great apes. The rule, however, usually holds true, particularly in respect to irreversibility over a considerable distance. What, then, is the genetic explanation for the tendency toward irreversibility in evolution, which is a perfectly genuine phenomenon? If a single mutation has taken place, subsequent mutations may be in any direction, including back to the original starting point. Such a backward mutation would be a case of reversible evolution. With any given gene, the chances of a reverse mutation are small, as there is an equal possibility for mutation in any other direction. If, now, one assumes a series of mutations in several genes to have taken place from a given starting point, to produce a given modified descendant, the probability of going through a series of backward mutations in reverse order, so as to reach the original condition, is so small as to be virtually negligible.[6] That is, assuming the chances of a backward mutation for a single gene as opposed to other types of mutations to be as 1:100, and that ten necessarily consecutive mutations of different genes have taken place in the evolution of a structure from that in the original form, obviously the chances of going through the same series of mutations in reverse order would be $1:(100)^{10}$ or 1:100,000,000,000,000,000,000, which is an extremely small chance. This explains why, for large evolutionary changes, the "law" of the irreversibility of evolution holds true, but also, how it is possible for the process to reverse itself where only a single point mutation is involved (or several successive mutations in a single gene).

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[6] If only a single gene is involved, it may go through several mutations and then return to the starting point in a single mutation. For example, in *Drosophila*, the wild type fly, with red eyes, mutated to one with eosin eyes, which mutated to white eyes, which then mutated back to red again.

SUMMARY

Extra incisors, canines and premolars in dogs probably are usually retained deciduous teeth, or, occasionally, may develop from split tooth germs. The extra molars of *Otocyon* appear to be due to the reduplication of the first upper and lower molars. The occasional appearance of the third upper molar in modern dogs is a genuine case of reversion to an ancestral stage, due to some one of the indicated genetic mechanisms. This illustrates the fact that the so-called law of the irreversibility of evolution cannot be considered as a law of the mechanism of evolution, but only as a summarization of the results usually observed.

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A GLACIAL COPPER NUGGET FOUND IN SAINT JOSEPH COUNTY, INDIANA

E. G. MAHIN

During the winter of 1926 a copper nugget of somewhat unusual size was found in a gravel pit, located near Niles Avenue of the City of South Bend. The nugget was discovered when it jammed in the crusher and, although slightly marked by the jaws of the crusher, it was recovered without substantial change having been made in its original form.

This piece of copper is in the form of a flattened, oblong disc, its maximum dimensions being 13 x 9 x 2 inches. The weight is 27 pounds.

In the opinion of Dr. K. B. Smith, Professor of Mining Engineering in the University of Notre Dame, this nugget was brought down from the Superior district by glacial action. The writer was chiefly interested from the metallographic, rather than the geological, standpoint and a single cut was taken near the end, so that a few specimens might be prepared for microscopic examination. Two or three interesting features were observed and these will be reported.

At the place where the section was taken the nugget appeared to be fairly sound, but with occasional small cavities containing crystals of some sort. Some of the latter were photographed and later analyzed. The appearance of the crystals was as shown in Fig. 1. They are remarkably well formed, as perhaps might be expected from the fact that they grew in free space. Chemical analysis proved them to be of cuprous oxide, Cu_2O, and no doubt they were formed through the oxidation of copper by enclosed bubbles of air while the copper mass was cooling.

Small sections of the copper mass were polished and etched with a solution of copper ammonium chloride. Fig. 2

shows a beautifully twinned crystal. The etching action produces the illusion of bas-relief, as though these crystals were lying *upon* some flat surface; this is, of course, not the case, as the polishing produces a single plane surface.

This particular crystal, and other similar ones, appear to indicate mechanical twinning, which may have resulted from what the metallurgist terms "cold work," which is mechanical distortion at temperatures below those where recrystallization may take place. This could easily have been accomplished by the crushing action of ice masses.

UNIVERSITY OF NOTRE DAME

A NATIVE COPPER NUGGET FOUND IN MARSHALL COUNTY, INDIANA

THOMAS H. VAUGHN

A small specimen of native copper was uncovered early in October, 1932, during operations in a gravel pit one mile east of Tyner, Indiana. Mr. Frank Haag, who discovered the nugget sent it to the Department of Chemistry in order that the find might be recorded. The nugget was found about twenty feet below the surface and had evidently been carried down from a northern lode by glacial action. Marks of glaciation were apparent in a number of deep broad longitudinal and lateral scratches.

The nugget was in the form of a rectangular slab roughly 11cm. long by 8 cm. wide by 2 cm. thick and weighed 1027 grams. A flat surface was ground on one end and the hardness of the specimen measured by means of a Vickers Testing Machine. The value so obtained were only slightly higher than those reported for pure copper. This indicates, in the opinion of Professor E. G. Mahin, that the nugget is practically pure copper alloyed with only a very small fraction of other metals.

Department of Chemistry,
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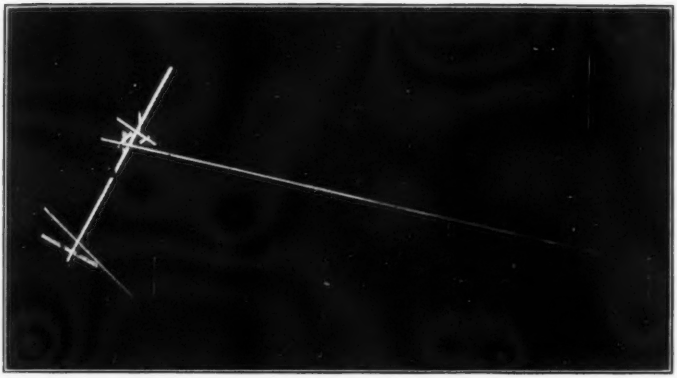

Fig. 1. Crystals of cuprite (cuprous oxide) found in a druse of a nugget of glacial copper. x 120.

Fig. 2. Copper crystal, an integral part of a glacial nugget. Mechanical twinning. x 500.

A NEW CHEMUNG EURYPTERID FROM PENNSYLVANIA[1]

BRADFORD WILLARD

I. INTRODUCTION

Eurypterid remains are almost unknown from the Chemung group of Pennsylvania. The data on those which have been found are summarized with descriptions and figures by Clarke and Ruedemann in their monograph, "The Eurypterida of New York."[2] According to these authorities, two specimens, each belonging to a different species of the same genus, *Stylonurus*, are all that are known from the Chemung of Pennsylvania. This material is incomplete in both instances. The two species are *S. excelsior* Hall and *S. beecheri* Hall. Both were collected in the vicinity of Warren in Warren County. An additional, fragmentary specimen of *S. excelsior* has also been reported from Delaware County in eastern New York State.

II. DESCRIPTION OF SPECIES

Order EURYPTERIDA Burmeister

Family EURYPTERIDAE Burmeister

Genus STYLONURUS Page

Stylonurus shaffneri sp. nov.

Stylonurus shaffneri sp. nov. is named for Mr. M. N. Shaffner of the Pennsylvania Topographic and Geologic Survey, co-discoverer of the fossil. It is based upon a single, ambulatory appendage excellently preserved as an impression and its natural cast. Some of the original, organic material is present as a carbonized film, but it is too much altered to show structure or surface markings. From comparison with figured specimens and restorations, it seems probable that the

[1] Published with the permission of the State Geologist of Pennsylvania.

[2] N. Y. State Museum, Memoir 14, 1912.

limb represents the fifth or more likely, the sixth from the right side of an individual whose other parts have perished. It most approximates the corresponding sixth appendage of the Silurian species *Stylonurus (Drepanopterus) longicaudatus* Clarke and Ruedemann.[3] The specimen was submitted to Dr. Rudolf Ruedemann who expressed his opinion that it probably represents a new species of this genus.[4]

From the impression and cast it is possible to study four complete limb segments and part of a fifth, having a total length along the anterior, convex margin of the impression of 41 mm. The segments are believed to be numbers 3, 4, 5, 6 and part of 7. Thus, numbers 1, 2, 8 and 9 are missing. Number 3 is short and thick, being 5 mm. long by 7 mm. wide. Number 4 is much longer than number 3, but not so wide. Its dimensions are 8.5 mm. long by 5 mm. wide. Number 5 is 10.5 mm. long and 3.5 mm. wide. Number 6 is very like number 5, but smaller, being 9 mm. long by 3 mm. wide. The incompletely preserved seventh segment suggests close resemblance to the sixth. It is approximately 8 mm. long by

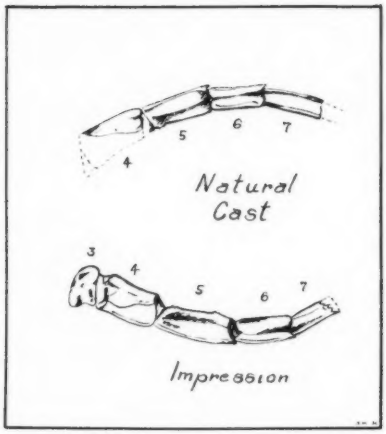

Fig. I. Limb of *Stylonurus shaffneri* sp. nov., dorsal surface.

[3] Ibid., pl. 54.
[4] Personal communication.

2 mm. wide. Except for number 3 which is thickest, each segment is roughly three times as long as wide. Distally from the body, each segment is successively more slender than the adjacent one; all are slightly curved, the convex side being the anterior. Each segment tends to be about 1 mm. wider at the distal than the proximal end, flaring slightly at the point of articulation with the next more distal. The superior surfaces, except for the third segment, are marked by a single, sharp, longitudinal ridge located near the posterior margin in the fourth, and progressively nearer the anterior edge in the successively distal segments. This ridge is the most distinctive feature of the species and serves to distinguish it from others of the genus. A single spine about 1 mm. long ornaments the anterior, distal corners of the fifth and sixth segments; and there are traces of more minute spines or their bases producing a serrated effect along the posterior margin of segment number 5.

Since *Stylonurus* is the only recorded Chemung genus of eurypterids, it is natural to refer the specimen thereto. However, comparison is necessary with at least two other genera. Of all other North American genera, only *Eurypterus* and *Pterygotus* are recorded by Clarke and Ruedemann[5] as being known from both older and younger formations than the Chemung, although they are not recorded from the Chemung itself. There is little more than general resemblance between the appendages of these genera and that of *Stylonurus shaffneri*. The surface ornamentation (i. e. ridges), intersegmental articulations and general proportions of the legs are unlike those of *Eurypterus*. The long, slender, smooth, rounded segments of the legs of *Pterygotus* are only remotely similar to the new species. As observed, the known *Stylonurus* species from the Chemung of Pennsylvania, *S. excelsior* Hall and *S. beecheri* Hall, are fragmentary; but their preserved appendages are sufficiently dissimilar from those of *S. shaffneri* to be readily distinguished. In *S. excelsior* the limb segments are marked by longitudinal, parallel ridges and grooves, a feature also present, but less strongly emphasized, in *S.*

[5] Ibid., p. 431, table of geologic ranges.

beecheri. The general form of the limb and the articulation, shape and ornamentation of the segments and their relative proportions to one another, are, however, unmistakably more like those found in the various species of *Stylonurus* than any other known, nearly contemporaneous North American eurypterid. Thus, the appendage is most like the corresponding one of *S.* (*Drepanopterus*) *longicaudatus*, but differs from that Silurian species chiefly in surface ornamentation; namely, the longitudinal ridge already described.

III. OCCURRENCE OF *Stylonurus shaffneri*

The newly discovered eurypterid remains from Chemung strata in Pennsylvania were collected from an outcrop along the west side of State Highway number 144, three and one-fourth miles south of the town of Galeton in Potter County. This locality is eighty-three miles east of Warren where all of the previously described Chemung eurypterids from Pennsylvania were found years ago. The lithology of the Chemung in north-central Pennsylvania is an alternation of green or olive-green to brown, often micaceous sandstones and shales. These beds are overlain by the alternating red and green sandstones and shales of the continental Cattaraugus ("Catskill") member of the uppermost Devonian. The fossil in question comes from greenish-gray, soft, clayey shale immediately beneath the Cattaraugus red beds and is therefore placed near the top of the Chemung. This position is corroborated by the local geologic structure,[6] which places the beds well down on the north flank of the north-northeast by south-southwest trending Marshlands anticline; and consequently high in Devonian sequence.[7]

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[6] For a discussion of the structure, see: Cathcart, S. H., Gas in the Tioga Region, Pennsylvania; Penna. Topog. and Geol. Survey, mimeographed bull. 102A, edition of January. 1932.

[7] A discussion of the Devonian faunas of the region will be found in: Willard, B., Devonian faunas in Pennsylvania; Penna. Topog. and Geol. Survey, bull. G4, pp. 21-34, 1932.

The associated fossils are abnormal for the Chemung, being:

BRACHIOPODA

Lingula cf. *spatulata* Vanuxem
L. cf. *ligea* Hall
Lingula sp.

PELECYPODA

Grammysia communis Hall
Nucula cf. *globularis* Hall
Nucula sp. nov.
Leptodesma longispinum Hall
L. elongatum Clarke and Swartz
Pelecypod, indet.

EURYPTERIDA

Stylonurus shaffneri sp. nov.

VERTEBRATA, Pisces

Bothriolepis, fragmentary plates, indet.

PLANTAE

Stem fragments, indet.

Lower in the Chemung, characteristic, marine invertebrates are common with *Spirifer disjunctus* Sowerby and associated forms dominant. The eurypterid, however, was found with a very different assemblage of fossils, chiefly inarticulate brachiopods and small pelecypods plus fragments of ostracoderm plates and stems evidently belonging to terrestrial plants. The deduced environment is consequently significant. Stratigraphically and lithologically the eurypterid-bearing beds pass by unbroken series upward into the continental Cattaraugus member and downward into beds characterized by a typical, marine, Chemung fauna. They are thus on the intermediate border between salt- and fresh-water types of sediments. The fossils substantiate this possible brackish-water condition. Although the remains are not those of a fresh-water facies, neither are they typical Upper Devonian marine types, since the "*Spirifer disjunctus* fauna" dies out below. The inarticulate brachiopods and at least some of the small pelecypods speak of salt- or brackish-water conditions. The plant remains suggest nearness to the shore line. The battered and broken condition of the ostracoderm plates implies that they may have belonged to stream-dwellers washed out into the sea or an estuary after death. The eurypterid it-

self may have had a like fate. The history of the order suggests a brackish- if not a truly fresh-water habitat in the late Devonian. Pre-Silurian and some Silurian Eurypterida are held to be marine organisms, but the post-Devonian ones are usually considered fresh-water inhabitants, leaving the intermediate forms presumably more or less in a transitional state.

PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY

THE PLEISTOCENE MOLLUSCA OF MISSOURI

D. K. GREGER

Very little has been published on the invertebrate fossils of the pleistocene deposits of Missouri, the results of examinations made by different individuals in various parts of the state, if published, are widely scattered in the literature. The writer has attempted in the following pages, to bring together the more extended lists of occurrences along with his own observations, covering a long period of collecting.

The earliest published list of Pleistocene fossils of Missouri was prepared by F. B. Meek, for the First Geological survey. The localities given are all along the Missouri River, from Council Bluffs, Iowa to the vicinity of Boonville, Cooper County and a list of ten species from St. Louis, Missouri.

The arrangement of the lists here presented, is from the northwest, across the state, to near the mouth of the Missouri River, north of the city of St. Louis and south to include the St. Louis Station.

CATALOGUE OF STATIONS AND SPECIES

Station 1: Opposite Mouth of Little Nemaha, Atchison County, (Meek 1855).

Helix multilineata
Helix profunda
Physa heterostrapha

Station 2: Opposite Mouth of Big Nemaha, Holt County, (Meek 1855).

Helix albolabris
Helix lineata
Helix multilineata
Helix striatella
Limnea umbrosa
Planorbis trivolvis

Station 3: St. Joseph, Buchanan County, (Sampson, 1913).

Bifidaria armifera
Polygyra divesta
Polygyra hirsuta
Polygyra monodon
Pyramidula alternata
Succinea grovenori

Station 4: Near Mouth of Platte River, Platte County, (Meek 1855).

Helix indentata
Helix lineata
Helix minuta
Helix multilineata
Helix striatella
Limnea fragilis
Limnea sp.
Physa elongata
Physa gyrina
Physa heterostropha
Planorbis armigerus
Planorbis trivolvis
Planorbis sp.
Pupa armifera
Succinea obliqua
Succinea ovalis?

Station 5: Lexington, Lafayette County, (Meek 1855).

Helix alternata
Helix profunda
Limnea fragilis

Station 6: Glasgow, Howard County, (Sampson 1913).

Polygyra multilineata
Pyramidula alternata
Succinea avara
Succinea ovals

Station 7: Boonville, Cooper County, (Meek 1855).

Helix electrina
Helix minuta
Helix occulta
Helix striatella

Station 8: Lupus, Moniteau County, (Sampson 1913).

Circinaria concava
Polygyra albolabris
Polygyra albolabris, alleni
Polygyra appressa
Polygyra elevata
Polygyra profunda
Polygyra thyroides
Pyramidula solitaria

Station 9: Providence, Boone County, (Sampson 1913).

Circinaria concava
Gastrodonta ligera
Polygyra abolabris
Polygyra alleni
Polygyra appressa
Polygyra clausa
Polygyra elevata
Polygyra hirsuta
Polygyra inflecta
Polygyra monodon
Polygyra pennsylvanica
Polygyra profunda
Polygyra thyroides
Pyramidula alternata
Pyramidula perspectiva
Pyramidula solitaria

Station 10: Near Mouth of Middle River, Callaway County, (Greger 1916).

Campeloma subsolidum
Gastrodonta ligera
Helcina occulta
Helicodiscus parallelus
Pleurocera sp.?
Polygyra albolabris
Polygyra hirsuta
Polygyra inflecta
Polygyra monodon
Polygyra profunda
Polygyra thyroides
Pyramidula alternata

Polygyra appressa
Polygyra clausa
Polygyra elevata
Polygyra fraterna
Pyramidula perspectiva
Pyramidula solitaria
Sphaerium transversum
Succinea ovalis

Station 11: Government Quarry, Mokane, Callaway County, Missouri, (Greger 1916).

Polygyra albolabris
Polygyra appressa
Polygyra appressa? (small var.)
Polygyra elevata
Polygyra multilineata
Polygyra thyroides
Polygyra fraterna
Polygyra monodon
Polygyra hirsuta
Polygyra zaleta
Zonitoides arborea
Zonitoides minuscula
Pyramidula solitaria
Pyramidula alternata
Pyramidula alternata (small var.)
Gastrodonta ligera
Helicodiscus parallelus
Vallonia pulchella
Vallonia sp.
Bifidaria contracta
Bifidaria armifera
Bifidaria procera?
Carychium exile
Helicina occulta

Station 12: South End of Quarry, Musick's Ferry, St. Louis County, (Greger 1932).

Anguispira alternata
Anguispira solitaria
Bulimulus dealbatus var.
Gastrocopta armifera
Haplotrema concava
Helicina occulta
Helicodiscus parallelus
Polygyra appressa
Polygyra elevata
Polygyra multilineata
Polygyra profunda
Polygyra tridentata
Strobilops labyrinthica
Succinea ovalis
Succinea retusa
Vitrea indentata

Station 13: Charbonnaiere Bluff, St. Louis, County, Mo. (Greger 1932).

Anguispira alternata
Anguispira solitaria
Bulimulus dealbatus
Gastrocopta armifera
Gastrocopta contracta
Haplitrema concava
Helicina occulta
Helicodiscus parallelus
Polygyra albolabris
Polygyra appressa
Polygyra elevata
Polygyra hirsuta
Polygyra inflecta
Polygyra monodon fraterna
Polygyra multilineata
Polygyra profunda
Pupoides marginatus
Strobilops labyrinthica
Succinea ovalis
Succinea retusa

Station 14: St. Louis City, (Meek 1855).

Amnicola lepidaria	*Helix hirsuta*
Helicina occulta	*Helix labyrinthica*
Helix arborea	*Helix monodon*
Helix concava	*Helix striatella*
Helix electrina	*Pupa armifera*

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BOOK REVIEWS

THE SCIENTIFIC BASIS OF EVOLUTION, by Thomas Hunt Morgan. New York: W. W. Norton and Company, 1932. 286 pp. $3.50.

THE CAUSES OF EVOLUTION, by J. B. S. Haldane. New York: Harper and Brothers, 1932. vii+235 pp., $2.50.

Professor Morgan contends that organic evolution has become the study of present processes, rather than historical series; that it has progressed so far in the field of experiment that its acceptance may rest "on the same scientific procedure that has led to the great advances in chemistry and physics."

The first of these statements he supports by an account of the evidence on inheritance and change that has been gathered by genetics. So far as it goes, his case is convincing: new forms have arisen and have become established, and it is purely an academic question whether or not they are comparable to species. On a basis of convenience, the taxonomist may decline to recognize them—yet no taxonomist will deny that many varieties and species have been named that are less distinct and less stable than genetic "races."

This achievement, however, does not obscure the weight of historical evidence, which Dr. Morgan classes as "circumstantial." Perhaps it is: yet an acquaintance with paleontologic series should temper his assertion that mutations occur at random, or that adult stages do not appear in ontogenetic recapitulation. I have dwelt elsewhere on the unsuitability of plants, mammals and insects for studies in this latter field, and have shown that the paleontologist, rather than the embryologist, is the one to pronounce judgment. Dr. Morgan merely repeats the statements made familiar by his *Evolution and Genetics*, neither acknowledging nor explaining away the work of Jackson, Hyatt, Truemann and many other paleontologists.

These limitations affect his statement that evolution is *primarily* an experimental science; they do not affect his contention that as a theory it may rest upon experimenatl evidence whose method is that common to physics and chemistry. To establish this, Dr. Morgan is forced to show the weakness of hypotheses such as emergence, holism and organicism, which adopt a different viewpoint. His criticisms are as effective as may be—yet he admits that is is on philosophical as well as pragmatic grounds that he adheres to mechanism. His mechanism, however, is not that of Haeckel: it is a cautious reliance on physics and chemistry, so framed that it will accommodate the changing concepts of both sciences. Dr. Morgan does not seek to limit the atom: but he objects with familiar vigor when Eddington, Bergson or Whitehead tell him

that atoms and energy will not suffice as the groundwork of living things.

Though incomplete on the side of history, *The Scientific Basis of Evolution* succeeds in presenting a very fair picture of the contributions of experimental biology, and the philosophic preferences of many of its workers. It is a convenient summary for those who, like the paleontologist, desire to know what geneticists are doing, yet are discouraged by the details and complexities of terminology which apparently must characterize original papers. If the scattered threads of Dr. Morgan's skepticism leave such readers at sea on problems of selection, use and disuse, Buffonism and Lamarckism, the remedy lies in further research rather than present generalization. To realize that they still are open problems is progress beyond traditional evolution, as embodied in more than one textbook.

Less ambitious in scope, but more so in substance, is Haldane's *Causes of Evolution.* It also reviews genetic evidence on heredity and variation within species, supporting the conclusion that new types in the breeding pen are comparable to those of nature. From this, Haldane turns to natural selection, and in terms free from mathematics restates his already published conclusion that selection (in the Darwinian sense) is a *vera causa* of evolution. Quoting di Cesnola on the mantis, Sapegin on wheats and Sukatschew on the dandelion, he shows that selection has occurred under critical observation; from the work of Bidder and Ridley, he concludes that apparently useless characters may be selected very effectively under the extreme conditions of disaster or migration. At the same time, he accepts the evidence of paleontology, relating it to the problem of fitness and emphasizing that mutations are not perfectly heterogenetic, and that most evolutionary change has been degenerative. His view, that "mutations only seem to occur along certain lines, which are very similar in closely related species, but differ in more distant species" conforms much more closely to the historical facts than does Morgan's opposed assertion. At the same time, it seems to limit the scope of natural selection, for which a mathematical analysis is provided in a forty-five page appendix.

These books well may be taken together: Morgan's as a general survey showing the influence of experimental methods on biologic theory, with the accompanying tendency to minimize historical or "circumstantial" evidence. Haldan's, on the other hand, gives a prophecy of the role to be played by mathematics and at the same time furnishes an insight into the still more modern method which draws no exclusive lines between experiment, analysis and history, but unites all in an attack upon a still puzzling series of problems.—CARROLL LANE FENTON.

PLANT SOCIOLOGY, by Dr. J. Braun-Blanquet. Translated, Revised and Edited by George D. Fuller and Henry S. Conard. New York: McGraw-Hill Book Company, 1932. xviii+439 pp. $4.50.

As it sometimes happens a study will arise, develop along many lines and for some length of time appear to the uninitiated as a chaos of terms and poorly organized thought before any attempt is made to summarize and arrange in suitable scientific form the facts shown and the ideas expressed. Thus every one interested welcomed Dr. Braun-Blanquet's *Pflanzensoziologie* which appeared 1928 in German. This book represented the first summary of its kind in a language more accessible to scientists than books of like nature, but published in unfamiliar tongues. As a result the book was well received and found wide acceptance, owing to its decided merits and the obvious need.

Two distinguished American ecologists have completed this translation and with the author's consent revised the latter. The English edition is thus brought up to date this having been necessitated by the rapid growth and expansion of the science. It was unquestionably a most fortunate choice and workers in the field here and abroad will be indebted to the translators for their revision. American literature has been given full credit within the available limits while the general scope shows a more cosmopolitan aspect, although researches of this kind have been more limited to the northern temperate zone than in many other fields of botanical investigation.

To the botanist unacquainted with plant sociology the book will serve as an excellent guide presenting the essentials in a well balanced manner and listing in a very extensive bibliography titles of immediate bearing upon the subjects discussed. In the same manner it should be useful as a text book familiarizing ecologists with methods employed by European and Eurasian investigators much to the mutual advantage of workers on both sides of the Atlantic. However one should not forget that the book does not represent a complete survey of plant sociology making the reading of source literature unnecessary. This was neither the intention of the author nor the aim of the translators and editors. Naturally the methods employed by the "Swiss school" are presented as standard while those of other "schools" are properly discussed and correlated.

The book is printed with the same well-known excellence that characterizes all the work of this publisher.—TH. JUST.

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